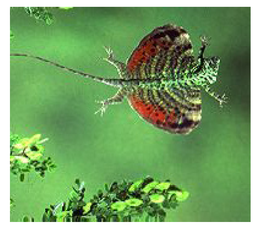
ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE
Laboratory of Intelligent Systems
http://lis.epfl.ch/microglider
M. Kovac, A. Guignard, J.-D. Nicoud, J.-C. Zufferey, D. Floreano

A 1.5g SMA actuated Microglider looking for the light

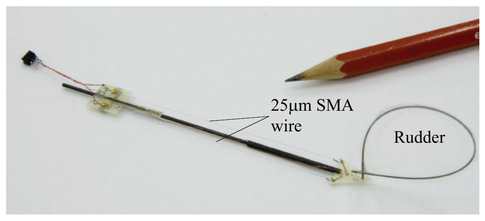


Motivation

In the animal kingdom, gliding is used to prolong jumps, escape predators and to rapidly reach a distant location, e.g. in birds, gliding squirrels, gliding fish, gliding frogs, flying lizards, gliding snakes or certain species of ants. We claim that climbing can be a powerful behavior for robots as well. It allows them to overcome ground obstacles or to cover relatively large distances in short periods of time.

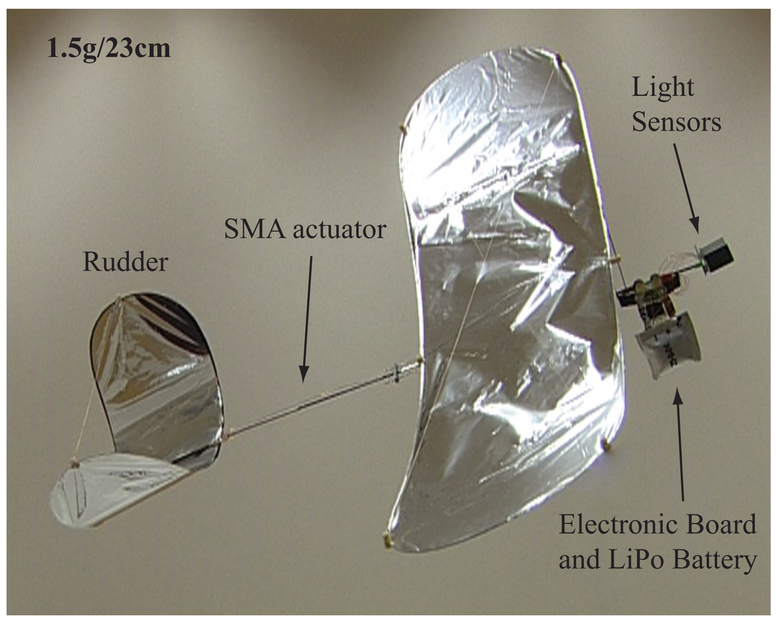
As a first step we developed a microglider weigthing a mere of 1.5g. It is equipped with sensors and electronics to achieve phototaxis, which can be seen as a minimal level of control autonomy. A novel 0.2g Shape Memory Alloy (SMA) actuator for steering control has been specifically designed and integrated in order to keep the overall weight as low as possible.

This microglider is the first step towards a novel novel palm sized robot of around 10g that is able to autonomously deploy itself from ground or walls, open its wings, recover in midair and subsequently perform goal directed gliding.

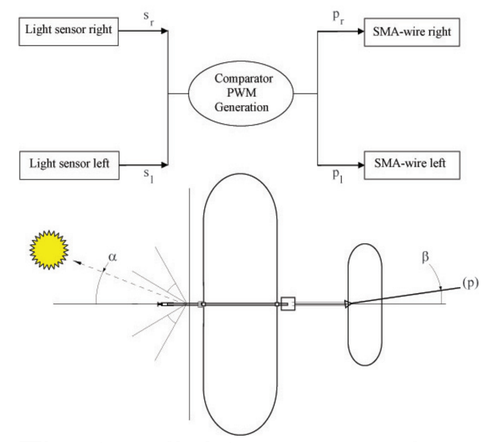


In order to reduce the weight maximally, we developed a **0.2g Shape Memory Alloy** (SMA) actuator for rudder control.

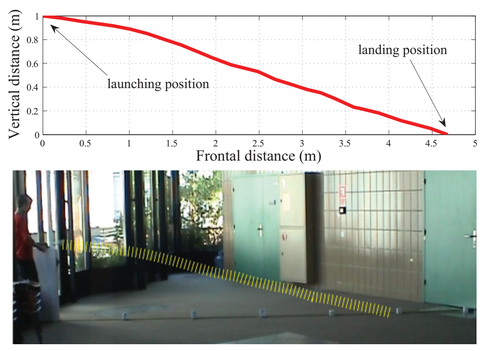
Robot

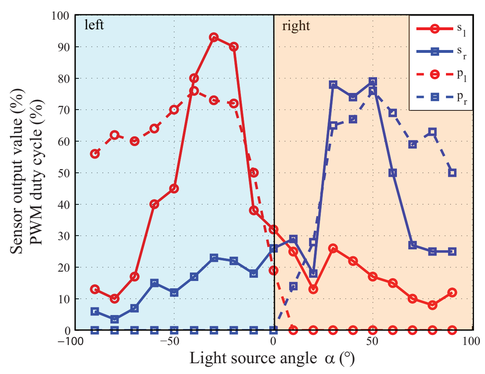


As a first step towards the exploration of goal directed gliding, we developed a 1.5g microglider. It is equipped with sensores and electronics to achieve phototaxis, which can be seen as a minimal level of control autonomy.

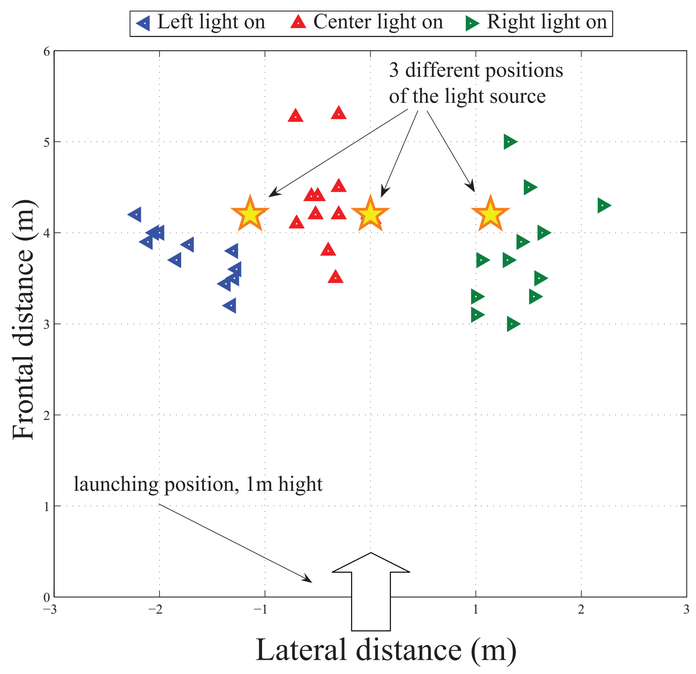


The two light sensor values are compared and a PWM signal is created and sent to the actuator.





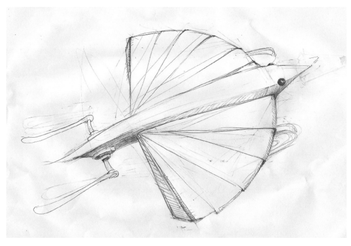
Flight at low Reynolds numbers (<10'000) is less efficient because of boundary layer effects. It is therefore crucial to optimize the wing shape and surface properties to yield good gliding performance. A gliding ratio of up to 5.6 has been achieved at an average gliding velocity of 1.5m/sec. This enables the microglider to navigate sucessfully in tight environments (e.g. entering doors etc.)



Summarizing, we present a 1.5g gliding robot that can do phototaxis as a first step towards a novel palm sized self deploying microglider. To reduce the weight, we developed a 0.2g SMA actuator for rudder control that is harmoniously integrated in the airframe structure. We show that gliding flight is an energy efficient and easy to use aerial locomotion method for small robots.

Reference

Kovač, M., Guignard, A., Nicoud, J.-D., Zufferey, J.-C., Floreano, D., A 1.5g microglider looking for the light, in *IEEE International Conference on Robots and Systems (ICRA'07)*, 2007, pp. 367-372



Future Work

The work in progress adresses the following areas:

- Wing folding mechanism
- Self deployment mechanism
- Autonomous recovery methods after deployment